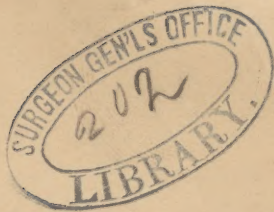


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## NAPHTHALINE AS AN INSECTICIDE, ETC.

### ITS EFFECTS ON SEEDS, PLANTS, INSECTS, AND OTHER ANIMALS.

By Dr. THOMAS TAYLOR, Microscopist of the U. S. Department of Agriculture.

*Read at the fifty-fourth regular meeting of the Biological Society of Washington, December 28th, 1883, held in the U. S. National Museum.*

ABOUT eleven years ago I had occasion to use large quantities of the dead oil of tar for commercial purposes. On removing the dead oil from the barrels I usually found a large quantity of solid matter deposited in them; it proved to be crude naphthaline which had precipitated from the "dead oil" on its cooling in the barrels.

Incidentally several bushels of the naphthaline were placed in an outshed and remained there undisturbed for a year, when I observed that its odor was in no way diminished. Being a coal-tar product, it occurred to me that it might be of service as an insecticide, and to that end I instituted a series of experiments with it on insects. I found that it had the power of producing a state of asphyxia. I also observed that different insects as well as the higher grades of animals were unequally affected. The winged phylloxera when immersed in the gas of this substance die almost instantly, while a full-grown potato bug under the same conditions would turn on its back and lie in that position for a week, manifesting life only by a slight movement of its limbs. In about ten days it dies; but, if not confined for too long a period, it recovers, and seems none the worse for the treatment. Their larva are quickly destroyed when the moistened powder of naphthaline is sprinkled on their bodies. The common ant will not cross over powdered naphthaline if it can avoid it. While confined in a jar containing a sprinkling of naphthaline they move about rapidly for a short period, but invariably under such conditions cast off their wings, first the right wing followed by the left in quick succession, and shortly afterwards roll on their backs and die if kept in the gas. Termites, which prove so destructive to timber in buildings, are much more easily affected by the gas than is the common ant. The common house fly seems quite spirited for a few minutes, but ultimately turns on its back, becoming asphyxiated; but a fly may be experimented with a great many times without apparent injury by exposing it to fresh air and odor

of naphthaline alternately, while if confined in the odor for too long a period it will die. The common large blue fly (*Musca Calephora*) if a female and pregnant invariably aborts when asphyxiated with the odors. This fact may be of some importance physiologically. After aborting the fly seems as lively as if it had not been subjected to the influence of the gas, and as if no change in its condition had occurred. Honey bees and wasps are affected in the same manner as house flies. Honey bees in the hive may be anesthetized by placing about an ounce of the pure white powder of naphthaline on the floor of the hive, and carefully watching the effects of the naphthaline on them when the bees are asleep; the hive may be uncovered and moths and honey removed.

If a small portion of naphthaline is placed in the holes of rats and mice they quickly vacate them and will not return until the odor of the gas has disappeared. Frogs, young and old, become asphyxiated in this gas, and die only when kept long under its influence, although I have seen a young frog remain torpid under its influence for a period of twelve hours, afterwards recovering from the stupor apparently in a healthy condition.

Several of the European governments have prohibited by enactment the importation into their dominions of plants, cuttings, bulbs, etc., from any country or district where the phylloxera of the grape-vine is found, with the view of preventing any further introduction of that insect into their vine-growing districts. I made the suggestion several years ago that a few grains of naphthaline be placed in small packages containing cuttings, bulbs intended for exportation; its odors would destroy nearly every description of insect present without injury to the plants.

Great loss is sustained by farmers through the introduction of a variety of insects into the United States from abroad through the medium of grain. In many cases this might be easily prevented by simply placing a small bag containing an ounce or so of naphthaline powder within the packages, as already mentioned, before shipment. By confining the naphthaline in bags the odor will permeate the entire sack of grain, and when desired the naphthaline bag with its contents could be easily removed. This might be useful, especially when the grain is intended for seed purposes.

About six years ago a sack of superior sorghum seed had been bought for distribution by the Agricultural Department. While it was in the seed-room one of the employés heard sounds pro-



ceeding from the sack; on my attention being called to it, I examined the seed and found it alive with minute beetles, which accounted for the sound. I placed a pint of these seeds into a quart bottle, and combined with them a small portion of pure naphthaline. Within an hour the sound ceased, and upon inspection the insects were found to be destroyed. These seeds were retained in the jar for a period of two years, and were planted (by Mr. Wm. Saunders, in charge of the propagating garden of the Agricultural Department) to test them. They germinated and grew, thus showing that the germ of the seed was uninjured. The odor of the naphthaline in the bottle which contained the sorghum seed was as strong as when first applied to it.

Although naphthaline has many practical uses, it has its disadvantages. The direct rays of the sun falling on it in exposed places causes it to evaporate, and thus quickly destroy its usefulness.

In applying it on open ground, insects, such as crickets, grasshoppers, and roaches, will simply avoid it, but when put in the ground near the roots of plants or trees it will have a beneficial effect, as the odors will drive away all insects or destroy them should they remain.

When combined with water it acts more quickly on the larva of insects than in the dry state. Worms, caterpillars, and even roaches and the larva of the potato bug, evince pain when the solution comes in contact with the tender parts of their bodies.

Large beetles resist its effects for several days. I have observed a black species of roach survive, while the common brown species died under the same treatment. One of the gardeners of the Department of Agriculture discovered one evening that a beetle was at work gnawing the leaves of one of his rose-bushes. On looking around he found that many of his bushes had been destroyed. This led him to dig up the ground around the bushes with the hope that the beetles would be found, and to his gratification and surprise he found about fifty full-grown beetles, measuring about an inch in length and nearly one-half inch in diameter. I procured several of these beetles alive, and subjected them to the odors of naphthaline for a reasonable time without producing stupor. Finding it was not likely that naphthaline could be successfully used as an agent for their destruction, it occurred to me that a still stronger chemical might give more satisfactory results.

For this purpose I used labarax solution (chlorinated soda.) In this solution chlorine exists in the free state, which is very offensive to insects.

I put a small portion of the labarax solution in an ounce vial, and placed it under a receiver, together with three full-grown rose beetles. The free chlorine issuing from the solution quickly filled the receiver, when the beetles began to move about rapidly. Within a few minutes it was evident that they were very much affected by the chlorine. In a short time they rolled over on their backs and died. For some purposes, therefore, the labarax solution might be employed with better effect than naphthaline. But it should be observed that delicate roots are quickly destroyed by chlorine.

Several years ago I made a number of experiments on plants growing in the hot-house of the Department in the presence of Mr. Wm. Saunders. Observing a large banana plant infested with ants, I sprinkled pure naphthaline on the ground around the plant. The ants, which were descending in thousands to the ground, retraced their march on discovering the naphthaline odor. Higher up on the banana plant they found the leaves and branches of a neighboring plant touching the banana, by which they were enabled to descend to the ground.

Insects on growing plants have been placed in a closet and under glass covers, and subjected to the odors of the gas, the insects were destroyed, particularly aphides.

On one occasion I removed a geranium with the earth attached from its pot, and cut about an inch of the earth and roots from it. A corresponding amount of pure naphthaline was put into the earthen pot and the plant replaced. A quantity of naphthaline was also placed on the surface of the pot, and watered in the usual way for a period of several days, but no evil effects were observed on the plant. In this experiment two earth-worms were found dead outside the pot, the odors having driven them from their abode.

About twelve months ago a quantity of peas was received at the Department of Agriculture. They were found to be half eaten and swarming with small beetles. I placed a pint of these peas in a jar with a small portion of naphthaline, which quickly destroyed the insects.

A few days ago I had planted in the hot-house of the Depart-



ment of Agriculture a portion of this same lot. They are in healthy growth, showing that the germs were not in any way injured, although confined for twelve months in this gas.

On last Saturday I placed these three tender plants in an atmosphere of naphthaline, and kept them in that state for a period of thirty-six hours, being thirty-five hours longer than was necessary for the destruction of minute insects. I observe that a single leaf on two of these plants has wilted. The third is wholly unaffected.

Since the above experiments were made I have subjected a young carp about four inches in length to the action of naphthaline, by placing an ounce of the drug in about two gallons of water, in which the fish was swimming. For a period of ten hours the fish was seemingly unaffected. On the following morning it was found floating on the surface dead. The cornea of both its eyes had become of a whitish translucent color; otherwise no peculiarity was observed.

As early as February, 1873, I recommended Dr. Jacqu  me, (a member of a scientific committee of Marseilles, France,) engaged in making experiments for the destruction of the phylloxera of grape roots, to use naphthaline in the ground for that purpose, in answer to which I received the following letter:

RUE SAINT-FERR  AL, 46,  
MARSEILLES, *February 13, 1873.*

MR. THOMAS TAYLOR,

*Microscopist, U. S. Department of Agriculture:*

DEAR SIR: I have received your letter and photographs, together with a copy of the agricultural report, for which please accept my thanks.

Experiments similar to those you mention were made in France, except that phenal was used instead of naphthaline. Pieces of porous wood are soaked in a solution of phenal and driven down, four in number, around each vine-plant. I do not know what was the result of those experiments. In the month of May I will call the committee's attention to the process you mention in order to experiment with it on some vine-plants, and I will in due course inform you of the result of our experiments.

Here is a process by means of which we saved some vineyards: In the months of April, June, August, and September—that is, four times during the period of vegetation—we injected at the roots of each plant 28 grammes of carbon sulphide. This was done with a syringe which makes a hole and at the same time thrusts the liquid into the soil. Four injections of 7 grammes of carbon sulphide each are sufficient for every application. Per-

haps this means is rather expensive, but it will permit us to save our plants.

With kind regards, I am truly yours,

JACQUEME.

On the evening of April 28, 1880, I read a paper before the members of the District of Columbia Horticultural Society on the subject of insecticide, recommending the use of naphthaline, to which the appended abstract is made by the secretary of the society alluded to:

Abstract from the proceedings of the District of Columbia Horticultural Society, at its meeting held at German Hall, April 28, 1880:

"Professor Thomas Taylor was called upon to read the essay announced by him at the last meeting, termed 'Insecticide in relation to Horticulture.' The essay abounded in much information in reference to the destruction of the grape-vine by the phylloxera, as well as many other insects destructive to plant life. The professor stated that in experiments made by him he had found that naphthaline was one of the best insecticides yet discovered, and gave a very extended account of many experiments made by its use upon insects, and that if the naphthaline was pure no injury would occur to the plants, but if impure, it would be injurious to plant life.

"An interesting discussion was then had, based upon the essay, participated in by Prof. C. V. Riley, Mr. John Saul, Col. Curtiss, and Mr. Wm. Saunders.

"On motion a unanimous vote of thanks was tendered to Professor Taylor for his very able essay.

"JOHN T. C. CLARK,

*"Secretary pro tem."*



